bottom, with a layer of felspar separating the two. A current of water sweeps through the whole, and is drawn off partly at the top, carrying with it the stone, and partly at the bottom, carrying with it the fine coal.

The above are instances where science has come to the aid of engineering. Here is one in which the obligation is reversed. The rapid stopping of railway trains, when necessary, by means of brakes, is a problem which has long occupied the attention of many engineers; and the mechanical solutions offered have been correspondingly numerous. Some of these depend on the action of steam, some of a vacuum, some of compressed air, some of pressure-water; others again ingeniously utilise the momentum of the wheels themselves. But for a long time no effort was made by any of these inventors thoroughly to master the theoretical conditions of the problem before them. At last, one of the most ingenious and successful among them, Mr. George Westinghouse, resolved to make experiments on the subject, and was fortunate enough to associate with himself Capt. Douglas Galton. Their experiments, carried on with rare energy and perseverance, and at great expense, not only brought into the clearest light the physical conditions of the question (conditions which were shown to be in strict accordance with theory), but also disclosed the interesting scientific fact that the friction between solid bodies at high velocities is not constant, as the experiments of Morin had been supposed to imply, but diminishes rapidly as the speed increases—a fact which other observations serve to confirm.

The old scientific principle known as the hydrostatic paradox, according to which a pressure applied at any point of an inclosed mass of liquid is transmitted unaltered to every other point, has been singularly fruitful in practical applications. Mr. Bramah was perhaps the first to recognise its value and importance. He applied it to the well known Bramah press, and in various other directions, some of which were less successful. One of these was a hydraulic lift, which Mr. Bramah proposed to construct by means of several cylinders sliding within each other after the manner of the tubes of a telescope. His specification of this invention sufficiently expresses his opinion of its value, for it concludes as follows:—"This patent does not only differ in its nature and in its boundless extent of claims to novelty, but also in its claims to merit and superior utility compared with any other patent ever brought before or sanctioned by the legislative authority of any nation." The telescope lift has not come into practical use; but lifts worked on the hydraulic principle are becoming more and more common every day. The same principle has been applied by the genius of Sir William Armstrong and others to the working of cranes and other machines for the lifting of weights, &c.; and under the form of the accumulator, with its distributing pipes and hydraulic engines, it provides a store of power always ready for application at any required point in a large system, yet costing practically nothing when not actually at work. This system of high-pressure mains worked from a central accumulator has been for some years in existence at Hull, as a means of supplying power commercially for all the purposes needed in a large town, and it is at this moment being carried out on a wider scale in the East End of London.

Taking advantage of this system, and combining with it another scientific principle of wide applicability, Mr. J. H. Greathead has brought out an instrument called the "injector hydrant," which seems likely to play an important part in the extinguishing of fires. This second principle is that of the lateral induction of fluids, and may be thus expressed in the words of the late William Froude:—"Any surface which in passing through a fluid experiences resistance must in so doing impress on the particles which resist it a force in the line of motion equal to the resistance." If then these particles are themselves part of a fluid, it will result that they will follow the direction of the moving fluid and be partly carried along with it. As applied in the injector hydrant, a small quantity of water derived from the high-pressure mains is made to pass from one pipe into another, coming in contact at the same time with a reservoir of water at ordinary pressure. The result is that the water from the reservoir is drawn into the second pipe through a trumpet-shaped nozzle, and may be made to issue as a stream to a considerable height. Thus the small quantity of pressure-water, which, if used by itself, would perhaps rise to a height of 500 feet, is made to carry with it a much larger quantity to a much smaller height, say that of an ordinary house.

The above are only a few of the many instances which might be given to prove the general truth of the fact with which we started, namely, the close and reciprocal connection between physical science and mechanical engineering, taking both in their widest sense. It may possibly be worth while to return again to the subject, as other illustrations arise. Two such have appeared even at the moment of writing, and though their practical success is not yet assured, it may be worth while to cite them. The first is an application of the old principle of the siphon to the purifying of sewage. Into a tank containing the sewage dips a siphon pipe some thirty feet high, of which the shorter leg is many times larger than the longer. When this is started, the water rises slowly and steadily in the shorter column, and before it reaches the top has left behind it all or almost all of the solid particles which it previously held in suspension. These fall slowly back through the column and collect at the bottom of the tank, to be cleared out when needful. The effluent water is not of course chemically pure, but sufficiently so to be turned into any ordinary stream. The second invention rests on a curious fact in chemistry, namely, that caustic soda or potash will absorb steam, forming a compound which has a much higher temperature than the steam absorbed. If, therefore, exhaust steam be discharged into the bottom of a vessel containing caustic alkali, not only will it become condensed, but this condensation will raise the temperature of the mass so high that it may be employed in the generation of fresh steam. It is needless to observe how important will be the bearing of this invention upon the working of steam-engines for many purposes, if only it can be established as a practical success. And if it is so established there can be no doubt that the experience thus acquired will reveal new and valuable facts with regard to the conditions of chemical combination and absorption, in the elements thus brought together.

WALTER R. BROWNE

THE LITERATURE OF THE FISHERIES EXHIBITION[1]

II.

THE depopulation of our littoral fisheries is the text of a paper on "Crustacea," by Mr. T. Cornish, who proposes to meet the difficulty by establishing a market for "middle-sized" Crustacea (and even fishes), other than those which we now eat, either as "luxuries or dainties." There is an amusing but authoritative air of originality about this paper. Mr. W. S. Kent, on the other hand, proposes the "Artificial Culture of Lobsters" as a remedy for the same evil, and recounts some interesting experiments made by himself—on a small scale—in which he succeeded in rearing the young lobsters taken captive. The leading developmental phases are set down for the guidance of others, but the account given is deficient in record of the earlier stages of the process. This is important, as the writer (presupposing

[1] Concluded from p. 36.

success such as has attended the artificial cultivation of the Salmonidæ) states, without apparent proof, that the cultivation might go on after the removal of the *eggs* from the parent. Should this be so, choice must then lie between the methods of Messrs. Cornish and Kent. The latter has overlooked the fact that our Irish lobster fisheries appear to be capable of much greater development, and we doubt how far an accusation brought against the "West-end chefs" is a logical one. We are at a loss to see the drift of Mr. K. Cornish's remarks, which form part of the discussion upon these two papers.

Early in the career of these meetings, our freshwater fisheries received attention at the hands of Sir Jas. Maitland, whose liberality in the matter of salmon-culture is well known in all fishing circles. The author, who regards the artificial propagation of the Salmonidæ as in its infancy, records the technique and results of a long practical experience, and indicates lines for future investigation, both as regards the migratory and non-migratory forms. He shows that by skilful attention he can rely upon hatching out 99 per cent. of Loch Levan trout ova, and, while discussing all sides of the question, he wisely points out that the object to be aimed at is "not to incubate the largest number of eggs in a given space," but so to manipulate them that "the largest number of healthy fish may result"—a statement involving difficulties for the study of which we must refer the reader to the paper itself. Intimately connected with this department is the question of the salmon-disease fungus, which forms the topic of a paper on "Fish Diseases," by Prof. Huxley. The author's investigations in the matter are well known to readers of NATURE, but all connected with freshwater fishing owe a debt of gratitude to the learned Professor for having thus sifted a voluminous literature upon the subject, and diagnosed in faultless style this pest. Its geographical limits are—for the first time—mapped out; the fuugus is shown to *cause*, and not merely accompany, the disease, and its propagation is conclusively shown to be favoured by causes which though unknown must necessarily be limited. Every inducement is given to the daily worker among these fishes to cooperate in the further study of the disease, in even the purely scientific aspects of which much yet remains to be done. The remarkable fact that the disease is in no way correlated with the "productiveness" of a river is fully demonstrated, and must carry its own lesson.

A somewhat analogous topic forms subject-matter for a paper on "The Destruction of Fish by Internal Parasites," by Dr. S. Cobbold. There is, however, the most marked contrast between it and that of Prof. Huxley, and we venture to say that the statements made on the first two pages and elsewhere, are calculated to frighten rather than encourage (by appealing to the experimental side) possible workers in a field for which the author claims so much. We are compelled to put this work down with a feeling of disappointment, the more so seeing that much of the space which might have been turned to better account is devoted either to a mere reiteration of statements made again and again by the author during the earlier sittings of the Conference, or to needlessly lengthy and verbose discussions upon minor points, to the exclusion of more important ones.

The all-important topic of "Food of Fishes" is attacked by Dr. Day. There is much in his paper that is of value, he having incorporated the observations of others with his own to the best advantage. The extreme importance of this subject is obvious to all concerned, but when—to say nothing of the question of inter-preying—we consider the extent to which it is known that the food of fishes may vary under conditions of most of which we know absolutely nothing, it is obvious that there opens up a field of labour, involving all sorts of side issues, work in which must necessarily be both prolonged and tedious. The paper, however, suggests certain lines along which a fruitful advance might be made. In the discussion which followed, the chairman (Prof. Huxley), taking a philosophic grasp of the question, resolves it into a balance in favour of "the ultimate store of food" furnished by "the Diatomaceæ which occur on the surface."

Mr. R. B. Marston, in an exceedingly practical paper on "Coarse Fish Culture," adduces reasons for which it is obvious that repopulation of our fresh waters must go on as matters stand, and can be very beneficially maintained. The question is one of growing importance, especially as it affects those who, although living far inland, still have the power of rearing good fish-food. We doubt, however, how far it is not possible to obviate certain of the difficulties mentioned, by more careful "nursing" alone. In advocating the introduction of the prolific Black Bass, the writer makes a statement, partly borne out by the experience of the Marquis of Exeter who first introduced the fish into Britain, but diametrically opposed by that of Sir Jas. Maitland—and which, if correct, is of great importance—viz. that it "thrives best in just those waters which are *not* suited to trout and salmon."

It is well known that the natural salmon stock of five of our largest rivers is practically exterminated, and that the fish present themselves annually at their unsavoury mouths, but to be baffled by causes, chief among which is that of pollution; in other cases, less markedly offensive, the fish are known to be slowly but certainly receding The Hon. W. F. B. Massey Mainwaring, in a paper upon "The Preservation of Fish Life in Rivers by the Exclusion of Town Sewage," first points out the main causes of actual death, and then proceeds to advocate the claims of the well-known A.B.C. process, exhibited by the Native Guano Company. For this he claims success, greater than that which has attended any such known chemical method, all at present pointing to irrigation and intermittent-downward-filtration, as the best solution of the difficulty. All the artificial breeding in the world cannot be of avail in waters thus becoming more deadly, and to the chemist the utilisation of waste offers a good field for work. There are other doubtful points about this paper, beyond the limits of a short notice, but it is sincerely to be hoped that when the present inquiry into the London sewage question terminates, the adoption of some treatment beneficial to our waters may perpetuate its action.

Closely allied are the interests of "Forest Protection," advocated by Mr. D. Howitz, the more especially as there is evidence to show that the disappearance of salmon has been at times associated with the clearing of forests. The author points out that, while the question has naturally more interest for other countries than our own, it is possible to maintain throughout the year, by the interaction of natural forces, a better equilibrium of life in shallow water. Although much yet remains to be done in this work, the arguments adduced are practical and weighty. The author advises the use of certain trees as being, from his own experience, preferable, the question of growth of timber not being overlooked.

All the aforementioned papers point indirectly to the "outcome" of the present movement, in so far as they suggest methods of improvement. Those which remain are either directly addressed to that subject itself, or to others demanding immediate attention.

Prof. Leone Levi brings forward a mass of statistical knowledge upon "The Economic Condition of Fishermen," stated to be "generally unsatisfactory." The paper abounds in useful information, not the least important being that which deals with the relationships existing between boat-owners and fishermen; the author also states that at present the workers are in proportion excessive "to the amount of production," and wisely recommends a "weeding" of those parasites—neither fishermen nor fools—said to exist. The "fortunes of the fisheries and agriculture in the last twenty years" are significantly

compared; but this and other matters dealt with are beyond the limits of our present notice.

In "The Principles of Fishery Legislation" the Right Hon. G. Shaw Lefevre, proceeding to deal with the sea fisheries, exclusive of Crustacea and littoral forms, recalls the circumstances which led up to the passing of the Sea Fisheries Act of 1868—the result of an inquiry before a Commission of which he was himself a member. This Act, essentially one repealing restrictive legislation and giving increased liberty, has lately, as our readers doubtless know, been much under discussion, and the statistics here brought forward speak for themselves as to the wisdom and successful working of the laws then laid down. When we consider the state of the question, as reviewed by the author, we must admit that to alter would be to mar such statutes as these, unless prompted by fresh acquisitions to our knowledge. Speaking of the littoral species, the author shows that restrictive action has exercised no beneficial influence whatever upon our oyster fisheries, and in connection with this subject good evidence has been brought before the Conference to show that actual harm has often been done by premature legislation. These considerations all point to a conclusion, reiterated again and again in the papers before us, and affording consolation to all save a small faction, which pleads injury, but for what reason we know not. This valuable paper is supplemented by one upon "The Basis for Legislation on Fishery Questions," by Lieut.-Col. F. G. Solá, Secretary to the Spanish Commission. Much of this paper is necessarily taken up in discussing Spanish fisheries, but the moral points in the direction indicated above. Speaking of "an absolutely restrictive system," the writer ably remarks that, "under the shade of those abuses established, recognised, or tolerated by former laws, there will have grown up a crowd of well-to-do interests, which it is not possible to disregard." These words and those which follow, will bear all the consideration we can give them.

Setting aside the popular sensational aspect of the "Fish Markets" question, of which those in authority have lately heard enough, that of "Fish Transports and Fish Markets" demands early consideration and prompt action. His Excellency Spencer Walpole, in dealing with it, confines himself to that "internal traffic" in which lie many sources of evil. Speaking of the necessity for railway reform, the author does not, as might be imagined, advocate State management, but seeks solution of the "suicidal policy" now existing, by insuring—between land and water carriage—a "healthy competition." All we can hope is that the matter may be thus easily rectified, meanwhile the fact remains that the future of great and important fisheries must depend upon the issue. The author enters into a discussion of the market question, but as so much concerning this rests with the City Corporation we await their views. Despite the protest lodged by Mr. Sayer on p. 20, we cannot but regard the silence of, and want of concerted action among, the Billingsgate men, as an unhealthy sign.

The perils of a fishing life are patent to all, and when we hear a cry raised on all hands for increased harbour accommodation, and read that the failure of our fisheries is often due to want of weather forecasts, it is obvious that an important claim is established. Mr. Scott, in a paper on "Storm Warnings," brings a well-known experience to bear upon this matter, and compares our own condition and apparatus with those of other countries, notably the United States, Germany, and Holland. Our greatest need at present is shown to be want of observatories on the west coasts of Ireland and Scotland, and the author points out the significant fact that "storm signals are hoisted at 111 stations only over the whole United States, while we in these islands have nearly 140 for a much smaller area." Speaking of the famed American storm-warnings, the need of mid-ocean observatories is discussed, as the storms almost invariably "change their character *en route*." Much other valuable information is embodied in this paper.

Prof. Lankester, writing on "The Scientific Results of the Exhibition," after making some admirable remarks about the "so-called practical man" and other topics, sets up a plea for a zoological observatory or "station." While no one will fail to enter into the spirit of his paper, we are of opinion that the plan—as concerning fisheries alone—need not be so elaborate as that suggested by him. No subject has created a greater revolution in the minds and actions of fishermen of late, than the discovery of Profs. Sars and Malm that the eggs of certain of our deep-sea fishes develop at the surface, and even were this not so no one would gainsay Prof. Lankester's cry of "more zoology." When we read that "the herring fishery is a lottery," and that simply because we know nothing of the real nature and causes of the movements of those fishes, it is quite obvious in what direction our earliest observations must be pursued. For this purpose a transportable zoological laboratory, with proper boats and appliances, such as that used in the recent successful experiments in the Netherlands, would amply suffice, and we conceive of such as best embodied in "A National Fishery Society," for which Mr. Fryer urges a strong, and it seems to us an exceedingly just, claim. All modern advance in the fishing industry points to the conclusion that Governmental action must be slight but firm; this being so, both common sense and precedent show it to be absolutely necessary that some such mediating body as that which the author would have established, should exist. Such a society would, of necessity, acquire in time all necessaries for work and progress, but, until this stage at least is reached, Britain—whose waters are second to none—cannot hope to hold her own in the matter of International Fisheries. We heartily recommend our readers to reflect upon a speech, made by Mr. Birkbeck, M.P., Chairman of the Executive Committee, which follows the aforementioned paper.

Such are the aims and scope of the Literature of the Great International Fisheries Exhibition, and when the remaining publications are forthcoming it will form a collection upon which both the fishermen and all concerned must be congratulated. It has been impossible to do more than indicate the general line of work in this brief notice, no note having been taken of the extent to which certain papers overlap; it will be obvious, however, where abuse lies, where reform is needed, and along what lines the expected "outcome" must proceed.

The style of these books, produced by Messrs. W. Clowes and Sons, leaves nothing to be desired; the few typographical errors which occur being unavoidable in dealing with the technicalities of such an extensive subject.

NOTES

THE adjudication of medals for the present year by the Council of the Royal Society is as follows:—The Copley Medal to Prof. Sir William Thomson, F.R.S., for (1) his discovery of the law of the universal dissipation of energy; (2) his researches and eminent services in physics, both experimental and mathematical, especially in the theory of electricity and thermodynamics; a Royal Medal to Prof. T. A. Hirst, F.R.S., for his researches in pure mathematics; a Royal Medal to Prof. J. S. Burdon-Sanderson, M.D., F.R.S., for the eminent services which he has rendered to physiology and pathology, especially for his investigation of the relations of micro-organisms to disease, and for his researches on the electric phenomena of plants; the Davy Medal to Marcellin Berthelot, For. Mem. R.S., and Prof. Julius Thomsen for their researches in thermo-chemistry.